

WHAT IS CLAIMED IS:

- 1 1. A filter cleaning device comprising:
2 a) a cleaning fluid delivery device for providing a cleaning fluid;
3 b) at least one actuator;
4 c) a controller with logic for instructing said actuator to automatically
5 move at least a portion of the cleaning fluid delivery device along a path across a
6 surface of the filter to spray the cleaning fluid onto the filter; and
7 d) a collector positioned to receive waste material released from the
8 filter during a filter cleaning event.
- 1 2. The device of claim 1 wherein said cleaning fluid delivery
2 device includes a nozzle that translates across the surface of said filter in two
3 perpendicular axes.
- 1 3. The device of claim 1 wherein said cleaning fluid delivery
2 device includes a nozzle that moves across the surface of the filter along a path
3 selected from one of the following: a rotational path, a curved path, or a spiral
4 path.
- 1 4. The device of claim 1 wherein said path is a predetermined
2 path.
- 1 5. The device of claim 1 wherein the cleaning fluid delivery
2 device comprises a nozzle coupled to an arm that is moved by said actuator that
3 guides the nozzle across the surface of the filter.
- 1 6. The device of claim 1 wherein the cleaning fluid delivery
2 device comprises flexible duct coupled to a source of high pressure fluid.
- 1 7. The device of claim 1 wherein the cleaning fluid delivery
2 device comprises means for delivering fluid to the filter.
- 1 8. The device of claim 1 wherein the cleaning fluid delivery
2 device is moved along a path to provide a substantially uniform level of cleaning
3 of said surface of the filter.

1 9. The device of claim 1 wherein said collector comprises
2 ducting which carries cleaning fluid and material released from the filter through a
3 filtering device and a suction device.

1 10. The device of claim 9 wherein said filtering device is selected
2 from one of the following: a HEPA filter or a ULPA filter.

1 11. The device of claim 1 wherein said filtering device is selected
2 from one of the following: a HEPA filter or a ULPA filter.

1 12. The device of claim 9 further comprising a second filtering
2 device positioned downstream of said vacuum device, said second filtering
3 device capturing materials flowing out from the vacuum device.

1 13. The device of claim 9 wherein said second filtering device is
2 a diesel particulate filter.

1 14. The device of claim 9 wherein said second filtering device is
2 a ceramic wall-flow particulate filter.

1 15. The device of claim 1 wherein said collector includes at least
2 one of: a HEPA filter or a ULPA filter.

1 16. The device of claim 1 wherein said controller can pulse the
2 cleaning pressure and fluid flow rate from the delivery device.

1 17. The device of claim 1 wherein said fluid delivery device is
2 coupled to a pulsing fluid source for pulsing the cleaning pressure and fluid flow
3 rate from the delivery device.

1 18. The device of claim 1 wherein controller automatically
2 determines when to stop a cleaning event.

1 19. The device of claim 1 further comprising a heating device for
2 heating cleaning fluid prior to use on the filter.

1 20. The device of claim 1 further comprising a fluid flow sensor
2 positioned to determine if a section of filter below the nozzle is more or less
3 clogged with particulate mater than regions of the filter around the section.

1 21. The device of claim 1 further comprising an air blower to
2 direct flow in the direction opposite to the previously applied cleaning fluid to
3 determine a pressure drop across the filter.

1 22. The device of claim 1 wherein said controller instructs the
2 actuator to move a nozzle of the delivery device at a relatively uniform distance
3 from the surface of the filter.

1 23. The device of claim 1 further comprising an electrical heating
2 element and supplementary air supply.

1 24. The device of claim 1 wherein the delivery device is adapted
2 for use with a suction mask to focus suction on the filter.

1 25. The device of claim 1 wherein the filter is coupled to an air
2 blower and heater-based regeneration system positioned to heat the filter prior to
3 application of the cleaning fluid.

1 26. The device of claim 1 further comprising a system wherein a
2 pressure drop across the filter in the reverse direction of cleaning fluid flow is
3 used as a process diagnosis.

1 27. The device of claim 1 further comprising a system with
2 reverse flow method of process diagnosis coupled to the filter.

1 28. The device of claim 1 wherein the actuator rotates the filter
2 while the nozzle sprays cleaning fluid onto the filter.

1 29. The device of claim 1 wherein the actuator rotates the filter
2 and rotates the nozzle about an axis outside of the filter to deliver cleaning fluid to
3 said filter.

4 30. The device of claim 1 wherein the actuator rotates a
5 rectangular nozzle about the central axis of the filter to deliver cleaning fluid to
6 said filter.

1 31. The device of claim 1 wherein a cleaning fluid nozzle may be
2 mounted to a plunger attached on the translation arm, said nozzle is pushed
3 down and held in contact with the face of the filter and allows the nozzle to follow
4 the contours of the surface of filter.

1 32. The device of claim 1 wherein a nozzle is made of an
2 abrasion resistant plastic.

1 33. The device of claim 1 wherein a nozzle on the cleaning
2 device moves through a pre-programmed set of positions, and optionally
3 monitors the flow rate at each position.

1 34. The device of claim 1 further comprising a blower wherein
2 the blower is switched to direct the flow of blower into the DPF in the direction
3 opposite to the previously applied cleaning fluid.

1 35. The device of claim wherein the pressure drop across the
2 DPF is measured using the pressure sensor and this value is compared with a
3 previously determined pressure drop for a clean filter.

1 36. The device of claim 1 further comprising a cleaning fluid
2 heater.

1 37. The device of claim 1 wherein said collector includes a
2 plurality of filtration stages.

1 38. The device of claim 1 further comprising a mask having an
2 uncovered section by focusing the suction force on a small area, thus
3 concentrating the suction near the region that is being treated with compressed
4 air. The mask is essentially a disk from which an arc has been cut,.

1 39. The device of claim 1 wherein a nozzle travels a path across
2 the filter until it reaches the center of the filter wherein a limit switch is engaged

3 which deactivates the main power relay that then in turn de-energizes the
4 solenoid, motor, and vacuum.

1 40. The device of claim 1 wherein the actuator rotates a multi-
2 port nozzle about the central axis of the filter to deliver cleaning fluid to said filter.

1 41. A filter cleaning device comprising:
2 a) a rotatable platform to which the filter is mounted;
3 b) a nozzle mounted to a moving arm for providing a high pressure
4 cleaning fluid;
5 c) a controller with logic for instructing actuators to move the
6 rotatable platform and the arm; and
7 d) a collector positioned to receive material which is released from
8 the filter during a cleaning event.

1 42. A method of filter cleaning, the method comprising:
2 a) using a cleaning fluid delivery device to providing a cleaning fluid;
3 b) using a controller to instruct an actuator to automatically move at
4 least a portion of the cleaning fluid delivery device along a path across a surface
5 of the filter to spray the cleaning fluid onto the filter; and
6 c) using a collector positioned to receive waste material released
7 from the filter during a filter cleaning event.

1 43. The method of claim 42 wherein said automatically move
2 comprises translating a nozzle across the surface of said filter in two
3 perpendicular axes.

1 44. The method of claim 42 wherein said automatically move
2 comprises moving a nozzle across the surface of the filter along a path selected
3 from one of the following: a rotational path, a curved path, or a spiral path.

1 45. The method of claim 42 wherein said path is a
2 predetermined path.

1 46. The method of claim 42 wherein said automatically move
2 comprises moving a nozzle coupled to an arm by said actuator that guides the
3 nozzle across the surface of the filter.

1 47. The method of claim 42 further comprising using a flexible
2 duct coupled to a source of high pressure fluid to deliver said fluid.

1 48. The method of claim 42 wherein the cleaning fluid delivery
2 device is moved along a path to provide a substantially uniform level of cleaning
3 of said surface of the filter.

1 49. The method of claim 42 wherein said collector comprises a
2 filtering device and a suction device.

1 50. The method of claim 36 further comprising using a second
2 filtering device positioned downstream of said vacuum device to capture
3 materials flowing out from the vacuum device.

1 51. The method of claim 36 wherein said second filtering device
2 is a diesel particulate filter.

1 52. The method of claim 36 wherein said second filtering device
2 is a ceramic wall-flow particulate filter.

1 53. The method of claim 42 wherein said collector includes at
2 least one of: a HEPA filter or a ULPA filter.

1 54. The method of claim 42 further comprising pulsing the
2 cleaning pressure and fluid flow rate from the delivery device.

1 55. The method of claim 42 wherein said fluid delivery device is
2 coupled to a pulsing fluid source for pulsing the cleaning pressure and fluid flow
3 rate from the delivery device.

1 56. The method of claim 42 wherein said controller automatically
2 determines when to stop a cleaning event.

1 57. The method of claim 42 further comprising using a heating
2 device for heating cleaning fluid prior to use on the filter.

1 58. The method of claim 42 further comprising using a fluid flow
2 sensor positioned to determine if a section of filter below the nozzle is more or
3 less clogged with particulate mater than regions of the filter around the section.

1 59. The method of claim 42 further comprising using an air
2 blower to direct flow in the direction opposite to the previously applied cleaning
3 fluid to determine a pressure drop across the filter.

1 60. The method of claim 42 further comprising moving a nozzle
2 of the delivery device at a relatively uniform distance from the surface of the filter.

1 61. The method of claim 42 further comprising using a suction
2 mask with the delivery device to focus suction on the filter.

1 62. The method of claim 42 wherein the filter is coupled to a
2 heater-based regeneration system positioned to heat the filter prior to application
3 of the cleaning fluid.

1 63. The method of claim 42 further comprising using a system
2 with reverse flow method of process diagnosis coupled to the filter.

1 64. The method of claim 42 further comprising using a pressure
2 drop across the filter in the reverse direction of cleaning fluid flow as a process
3 diagnosis.

1 65. The method of claim 42 wherein the actuator rotates the filter
2 while the nozzle sprays cleaning fluid onto the filter.

1 66. The method of claim 42 wherein the actuator rotates the filter
2 and rotates the nozzle about an axis outside of the filter to deliver cleaning fluid to
3 said filter.

4 67. The method of claim 42 wherein the actuator rotates a
5 rectangular nozzle about the central axis of the filter to deliver cleaning fluid to
6 said filter.

1 68. The method of claim 42 wherein the actuator rotates a multi-
2 port nozzle about the central axis of the filter to deliver cleaning fluid to said filter.